

**2005 APPLICATION
for
INNOVATIVE BRIDGE CONSTRUCTION PROGRAM**

State _____ State's Priority Ranking: # _____ of _____

Project type (new construction, replacement, rehabilitation, or repair) _____
NBI structure number _____ County _____

Structure Name and/or Identifying Description (e.g. Number/Name of Route on the Bridge and Feature Crossed) _____

Structure description (e.g., bridge type, number of spans, length, width, material)

Innovative material and/or innovative accelerated construction (describe the material and/or construction, how it is used and how the project meets one or more of the program goals)

Cargill's SafeLane™ ice prevention overlay system is a pavement overlay based on Type III epoxy overlay systems and aggregates already approved and in use by several state DOT's. In addition to sealing the bridge deck to seepage of corrosive deicing materials into the pavement and providing a durable and rapidly installed overlay, the SafeLane system also provides a reservoir for anti-icing chemical that is released when a frost or icing event occurs. This innovative material was developed at the Keweenaw Research Center at Michigan Technological University to solve the problem of persistent frost and ice formation on bridges.

Figure 1 below is an illustration of the components of the SafeLane overlay.

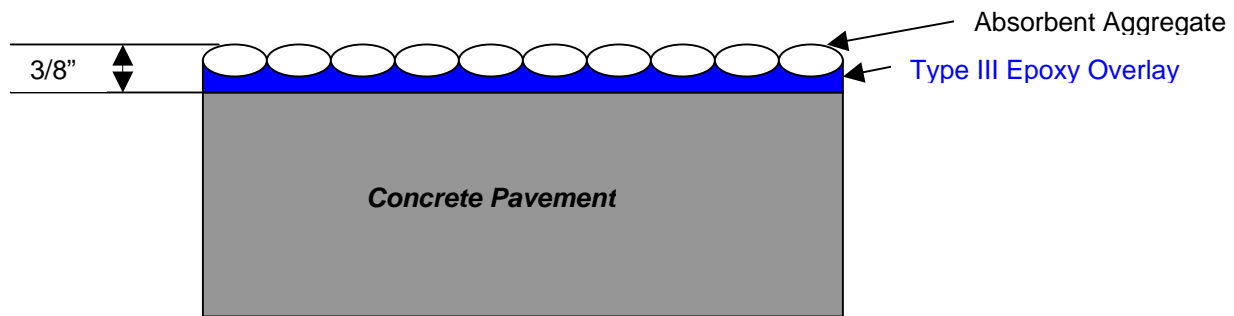


Figure 1

The absorbent aggregate is embedded into the epoxy overlay immediately after application of liquid epoxy adhesive onto the pavement and when the epoxy is cured (2-6 hours), the aggregate

becomes permanently adhered to the pavement surface. Figure 2 below illustrates how the SafeLane ice prevention overlay system works.

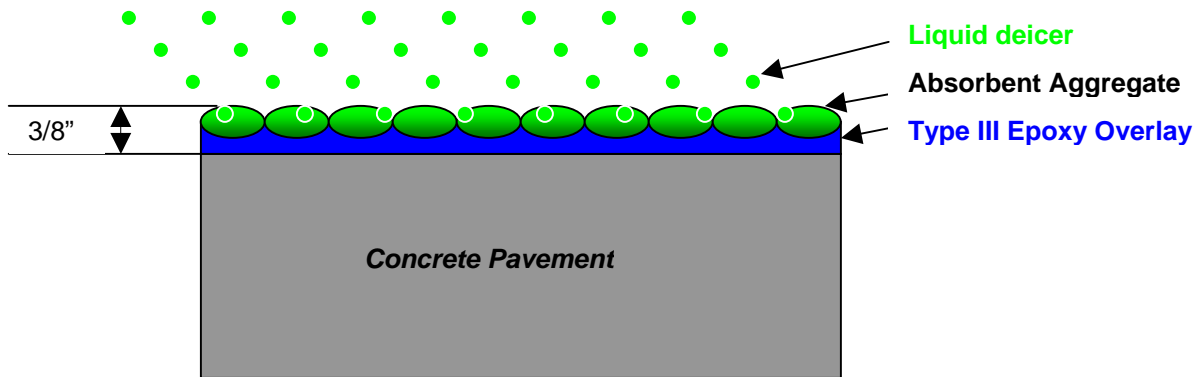
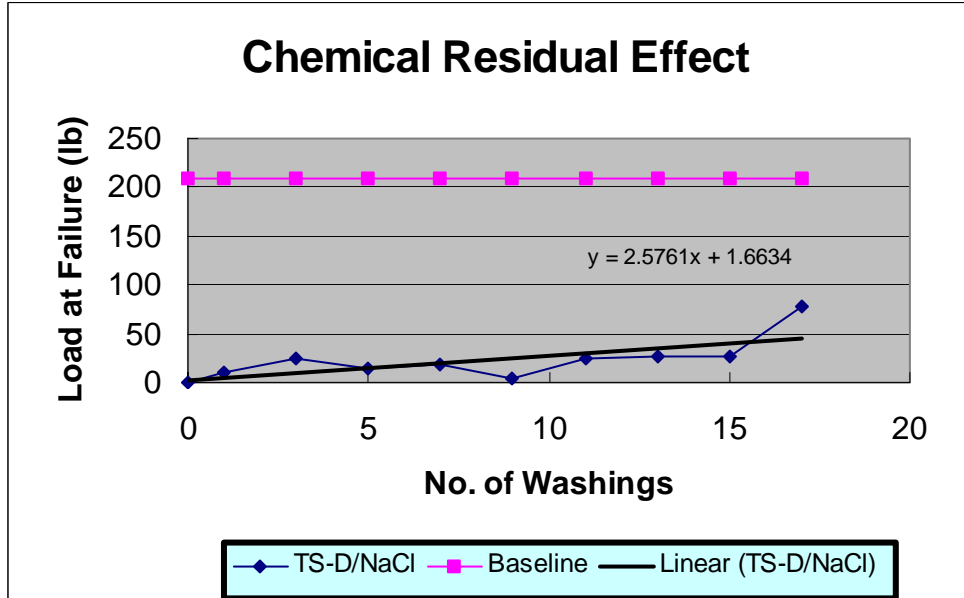


Figure 2

Liquid deicer is applied to the absorbent aggregate and is retained in the aggregate. The anti-icing effect is activated when the temperature drops below freezing and there is enough ambient moisture present to cause ice or frost formation on pavement. The “chemical residual effect” of the deicer chemical prevents the formation of frost or ice on the aggregate surface and this effect is retained for extended periods of time and resists being washed out by rain or traffic.



Laboratory tests indicate that use of deicer chemicals in anti-icing applications may be reduced to as little as 20% of the amount that would normally be used. Figure 3 above shows the results of a study done at the Keweenaw Research Center examining the effects of repeated washings of SafeLane overlay test samples on ice formation. The pink “control” curve is the bond strength apparent on the sample before application of chemical. This “control” bond strength is essentially a measure of the presence of ice present on the surface of the sample. It is obtained

by water wetting a 2”x 2” square sample of a pavement and bonding it to a wetted sample of 2”x 2” sample of water wetted SafeLane overlay that has not been treated with deicer. The wetted sides of these samples are sandwiched together and exposed to a temperature of 20° F. This causes the water to freeze, forming an ice layer between the samples and adhering them together. The samples are then sheared apart with an Instron to measure the bond strength of the ice layer. As expected, this results in is a relatively high, constant value due to the tenacious nature of the bond of the ice to the pavement and the SafeLane overlay. The blue curve shows the bond strength of samples prepared the same as the control except that SafeLane overlay sample has been treated with a sodium chloride brine solution. The black line is a best-fit regression of the data. Figure 5 shows a trend that even after repeated washings, the bond strength stays quite low. This means that snow will not bond or pack on the surface during a snowfall event. Similar laboratory tests (Figure 4) show that the residual deicing chemical virtually eliminates frost growth on the surface, and liquid water does not freeze or form a bond.

Sample	Number of Scrubs	Time in Frost Chamber (hr)	Frost Chamber Temperature °F	Results
SafeLane™ / Control	75	72	20	Layer of frost on surface
SafeLane™ / Potassium Acetate Liquid	75	72	20	No frost. Moist surface.
SafeLane™ /Calcium Magnesium Acetate Liquid	75	82	20	No frost. Moist surface.

Figure 4

Figure 4 graphs test results of the SafeLane overlay samples. The control sample is untreated and the other two samples were treated with different deicer solutions, potassium acetate on one sample and calcium magnesium acetate on the other sample. These samples were scrubbed with 75 strokes of a bristle brush under a continuous stream of tap water before they were inserted in the frost chamber. Scrubbing the samples was meant to duplicate rain or sleet condition with traffic passing over the overlay surface. In the frost chamber, the samples were exposed to a continuous fine mist of water at a temperature of 20 °F for 72 hours. As noted in Figure 4, the SafeLane overlay samples showed no signs of frost on the surface and the surface remained moist while the control sample showed formed frost on the surface. This lack of frost on the treated samples indicates the presence of an anti-icing effect. In addition, scrubbing the samples after treating demonstrates that the anti-icing effect remains even if it rains between frost or icing events. It is important to note that other common deicing liquids such as sodium chloride brine and magnesium chloride liquid deicers provide equal or better anti-icing effects when applied to the SafeLane overlay than potassium acetate or calcium magnesium acetate liquids.

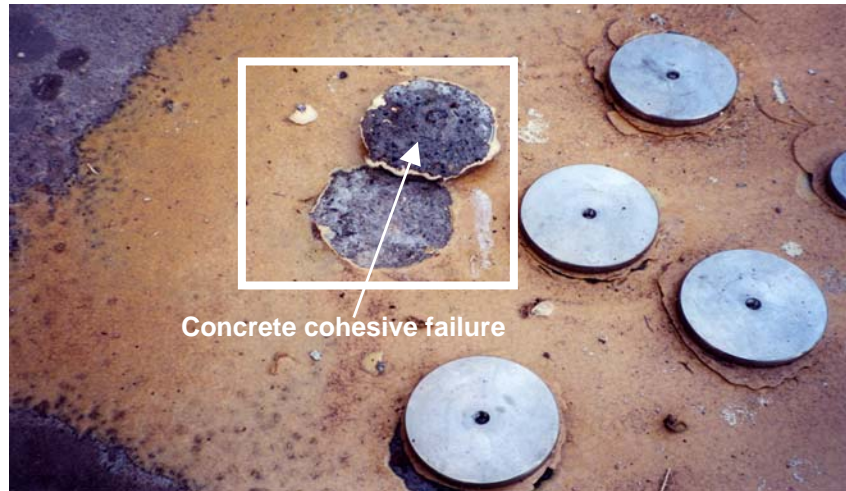


Figure 5

As shown by Figure 5 the adhesion of the epoxy overlay system to pavement is stronger than the pavement itself making it very resistant to traffic and plow damage. A James Bond Tester was used to determine the bond strength of the epoxy on concrete. As the sample in the upper left of Figure 5 shows, the concrete cohesively fails before the epoxy bond to the concrete fails.

A study by the Keweenaw Research Center titled *Field Performance of Polymer Bridge Deck Overlays in Michigan* performed for the Michigan Department of Transportation's Construction and Technology Division states "materials being used today exhibit a bond strength that is generally higher than the tensile strength of the concrete deck." This same study concludes that "these systems are quite useful for increased friction as well as prolonging the life of a pavement by sealing out unwanted moisture and chlorides." Service life of these overlay systems are projected to be "15 years or longer".

As shown by Figure 6 below, SafeLane ice prevention overlay has the appearance of a textured pavement.

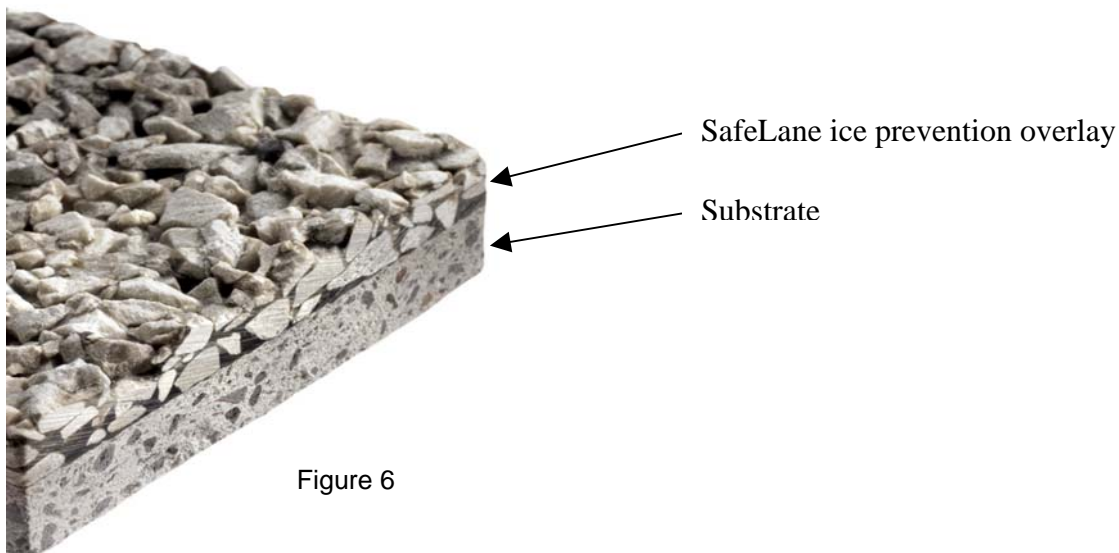


Figure 6

Saab Friction Tester results rated SafeLane overlay at “90” and ordinary paving concrete at “88” showing that the SafeLane overlay has about the same traction characteristic as concrete and even better in some cases.

A test site was installed on a bridge on Highway 8 near Crandon, Wisconsin in the summer of 2003. This site has successfully demonstrated the SafeLane ice prevention system performance. This bridge is located over a swampy area with Wolf River running through. It has a history of accidents caused by slippery spots resulting from persistent frost present on the bridge as a result of the humidity generated by the water present under the bridge. A quote from Ron Cole – Patrol Superintendent, Forest County Highway Department, Wisconsin illustrate the effectiveness of the SafeLane overlay. “The bridge over the Wolf River is elevated and the deck would ice over very easily. Traditional salting was not working, and people would drive across the bridge, lose control and hit the guardrail.” Traditionally the bridge has had an average of 3-4 reportable accidents per year for the past 9 years. Since the SafeLane overlay has been installed, there have been ZERO accidents reported. Mr. Cole adds, “We had no calls, no complaints, and most importantly, no accidents.” They have also realized a reduction in the amount of chemical they use to treat the bridge. Before the installation of the SafeLane system, crews treated the bridge twice per week to try to control frost formation. Since then, they’ve treated the bridge, depending on the number of storm events, from once to twice per month.

In addition to the safety benefits, fewer call-outs of anti-icer crews result because there is not a need to apply the anti-icer in reaction to a weather forecast as the anti-icer is already in place at the site. Fewer call-outs and reduced reliance on weather forecasts will decrease the cost of operating the anti-icer operation of a bridge that has SafeLane overlay installed on it. These costs savings result from the ability to schedule deployment of anti-icer crews and equipment. Other cost saving will also result from reduced anti-icer chemical usage, call-outs and reduced bridge corrosion.

INNOVATIVE BRIDGE CONSTRUCTION PROGRAM GOALS

SafeLane overlay meets 4 of the 7 program goals as outlined in 23 U.S.C. 503(b)(3)(B) for the Innovative Bridge Research and Construction (IBRC) program as established in TEA-21.

1. The development of new, cost effective, innovative material highway bridge applications.

SafeLane overlay can be considered a “smart” material as it makes deicer continuously available at the overlay surface whenever it is needed to prevent frost or ice. SafeLane overlay works by taking advantage of a residual chemical effect imparted by the deicer liquid onto the aggregate. The deicer is available at any time that conditions occur to form ice or frost. It is the result of recent research completed at Michigan Technological University’s Keweenaw Research Center and is recently become available for commercial implementation.

The SafeLane system offers benefits such as corrosion reduction, anti-icing effects and traction control and can be installed over existing pavements quickly and efficiently. Because it is light in weight, it may be used multiple times without adversely affecting bridge deck loads thus extending the life of a bridge deck and reducing the need for costly bridge deck replacement.

2. *The reduction of maintenance costs and life-cycle costs of bridges, including the costs of new construction, replacement, or rehabilitation of deficient bridges.*

SafeLane ice prevention overlay is a pavement overlay based on Type III epoxy overlay systems and aggregates already approved and in use by several state DOT's. Epoxy overlays are already being used to rehabilitate pavement surfaces on bridges in many state DOT's. The SafeLane overlay has a bond strength to the concrete deck that is generally higher than the tensile strength of the concrete deck. Therefore, the SafeLane overlay forms a very durable surface that resists plow damage and pavement spalling or chipping.

The constant availability of deicer on the SafeLane system reduces the need for weather forecasting and applying deicer liquids as anti-icer in response to a weather forecast. In fact, it is preferable to deploy anti-icing crews and equipment during dry conditions to apply the deicer onto the SafeLane overlay. Applying anti-icer liquids in these conditions allows it to soak in and be stored and ready when the next icing or frost event occurs. Therefore, anti-icing operations can be scheduled as part of routine maintenance activities rather than as a reactive activity. This creates improved efficiency of anti-icing operations as it allows more efficient deployment of crews and equipment. In addition, use of corrosive deicers is reduced to as little as 20% of the amount used in traditional anti-icing programs. This substantially reduces call-outs for crews and equipment further reducing anti-icing costs for a bridge with SafeLane overlay installed.

The SafeLane ice prevention overlay enhances bridge integrity and decreases vulnerability to damage from both natural and manmade hazards. This overlay system enhances bridge integrity by reducing bridge steel corrosion because the overlay seals the pavement and prevents seepage of the deicer chemicals(chlorides) through the pavement. In addition, bridge structural steel corrosion will likely be reduced because of the lower volume of deicer applied and splashed onto the steel by traffic. From laboratory tests and field application, it is estimated frequency of deicer liquid application may be reduced to as little as 20-25% of the current required frequency. In addition, retention of deicer liquid in the aggregate will also reduce splash-back onto the bridge structure. Reduced splash-back will lower the corrosion to exposed steel on the bridge structure. Less corrosive deicer liquids may be used such as potassium acetate or calcium magnesium acetate further reducing the potential for corrosion of bridge steel. Another benefit is reduction in run-off of deicer and resulting chloride release into the environment. This makes the installation of the overlay beneficial to environmentally sensitive sites where chloride run-off is a concern.

According to an article entitled, *High Tech Comes to Bridge Deck Materials* in the May, 2004 issue of *Better Roads*, the costs of rehabilitation of a bridge deck is approximately \$17.50 per square foot. On suitable bridge decks, the SafeLane overlay will cost approximately \$9 per square foot to install. Life expectancy of this repair is comparable to asphalt overlay repairs and is expected to last 12-15 years. This compares very favorably with the costs of \$35 per square foot for newly constructed bridge that have an expected life of 20 years. Another advantage of SafeLane overlay is that it may be installed over itself with a minimum of surface preparation. Therefore, bridge deck life may be extended even further if a new SafeLane overlay installation is applied over an old installation.

3. The development of construction techniques to increase safety and reduce construction time and traffic congestion.

Although there are many maintenance benefits associated with the SafeLane system, the biggest benefit is a safer road surface, which has resulted in reduced accidents in field tests. Since the SafeLane system was installed in 2003, it has consistently performed at the Crandon site and has successfully eliminated the formation of ice and frost that caused several accidents in the previous years.

Construction time to install a pavement overlay is reduced because it is based on Type III epoxy and aggregate systems already approved and in use by several state DOT's. These proven techniques and materials allow the SafeLane overlay to be applied on the traffic lane quickly and the lane can be back in service in as little as 12 hours.

4. The development of engineering design criteria for innovative products and materials for use in highway bridges and structures.

The SafeLane system is a combination of two innovative materials in a bridge component that best utilizes the high performance characteristics of each material. SafeLane overlay combines innovative epoxy overlay systems already in service to seal the deck and extend the bridge deck life. This is combined with unique, absorbent aggregates to create to provide anti-icing effects when they are needed.

Schedule for start of work (month/year): _____

Cost Estimates:

Total project cost:	P
Cost of "innovative material" portion of the construction	A
Preliminary engineering cost, if requested	B
Cost of innovative material performance evaluation (e.g., for a 2-year post-construction period)	C
PE costs + construction costs + evaluation costs = (A + B + C)	T
Total Federal Program Funds Requested	\$\$ _____

State Department of Transportation Contact Person

Name: _____
Title: _____
Agency: _____
Ph: _____
Fax: _____
E-mail: _____

Local Agency Contact Person (if applicable):

Name: _____
Title: _____
Agency: _____
Ph: _____
Fax: _____
E-mail: _____

FHWA Division Office Contact Person:

Name: _____
Title: _____
Agency: _____
Ph: _____
Fax: _____
E-mail: _____